ABSTRACT

In an electrostatic copier a switch can be operated for initiating a copying sequence. A number wheel is mounted on the shaft and can be turned from a zero position to a plurality of operating positions in each of which it preselects a specific number of repetitions of the sequence. An externally accessible knob is provided for turning the shaft manually to place the number wheel in the desired operating position. A device is provided which incrementally returns the number wheel to zero position as each of the respective sequences is executed. An additional device is provided which is operated every time the switch is actuated and which causes the number wheel to move from its zero position to a respective operating position incrementally in dependence upon the number of times the switch is operated.

12 Claims, 1 Drawing Figure
PREDETERMINED COUNTER FOR ELECTROSTATIC COPYING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates generally to copying apparatus, and more particularly to an electrostatic copier. Electrostatic copiers are well known enough not to require a detailed description. For purposes of the present invention, it is pointed out, it is immaterial in what specific way they effect the production of a copy.

Various different types of electrostatic copiers are known. These differ in various respects from one another, but in each one it is necessary that—if a series of several copies of the same original is to be made—the number of copies which it is desired to make be preselected by setting manually a preselecting switch provided for this purpose. If, for instance, a relatively small number of copies is to be made, say four copies, then the effort required for setting the repeat switch or preselecting switch is out of keeping with the results which are to be obtained, in so far as the time required for setting the preselector is concerned.

Although it is clearly desirable that an improvement should be found concerning this problem, no such improvement heretofore has been forthcoming.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention to provide such an improvement.

More particularly it is an object of the present invention to provide an electrostatic copier which is not possessed of the aforementioned drawback.

Still more specifically it is an object of the present invention to provide an electrostatic copier in which it is not necessary to preselect a number of copies to be made via the preselector, although this is still possible if and when desired.

At the same time it is an additional object of the invention to provide such an improved copier which is relatively simple and therefore reliable in its operation.

In pursuance of the above objects, and others which will become apparent hereafter, one feature of the invention resides, in an electrostatic copier, in a combination of first means operable for initiating a copying sequence and second means which is incrementally advanceable in a first direction from a zero position to a plurality of operating positions in each of which it preselects a specific number of repetitions of said sequence. Third means is provided for manually advancing the second means in the aforementioned first direction and fourth means is provided for incrementally returning the second means in a second direction opposite the first direction towards the zero position in response to execution of the respective copying sequence. Finally, there is also provided a fifth means connected with the first and second means and being operative for incrementally advancing the second means in the aforementioned first direction in response to operation of the first means.

The second means comprises a number wheel which is mounted on a turnable shaft which can be turned manually by means of the third means to thereby preselect the number of copies which it is desired to make. At the same time, however, the present invention provides for gears mounted on this shaft and cooperating with electromagnetically operated paws which, when they are actuated, either advance the shaft in a sense moving it from zero position to a respective operating position, or in a sense returning it from the respective operating position towards the zero position. With this arrangement a relatively large number of copies can be preselected by setting the second means to the desired operating position via the third means, just as before. On the other hand, a smaller number of copies need not be preselected in this manner, but can instead be preselected by rapidly operating the first means—which is usually the start switch of the copier—for a number of times corresponding to the number of copies it is desired to make. This can be done so rapidly and so con-
be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

**BRIEF DESCRIPTION OF THE DRAWING**

The single FIGURE is a perspective view, combined with a circuit diagram, of an apparatus embodying the present invention.

**DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Before discussing the FIGURE in detail it is emphasized that only those components of an electrostatic copier have been illustrated which are provided in accordance with the present invention, or which are of importance for an understanding of the present invention. All other components have been omitted for the sake of clarity and it is emphasized that all such components which are not shown may be entirely conventional and are well known to those skilled in the art.

With this in mind, and now discussing the FIGURE in detail, it is pointed out that a shaft 1 is indicated with reference numeral 1 and is turnable about its longitudinal axis, being mounted in suitable manner for this purpose. Secured on the shaft 1 for rotation therewith is a number wheel or preselector wheel 2 whose circumferential edge face is provided with a plurality of setting-indicating or position-indicating indicia each of which indicates the number of repeat copies which has been preselected. In the illustrated embodiment the number wheel 2 has 27 operating-position settings, a zero position setting, and a multi-copy or continuous-copy setting M. An index indicator 3 shows to which particular position the wheel 2 has been set. Accessible at the exterior of the copier is a knob 4 which permits turning of the shaft 1 manually until the desired setting (indicating the number of copies which are intended to be produced) is located opposite the mark 3.

As the drawing shows, the wheel 2 is not the only component mounted for turning movement on the shaft 1. There is further provided a gear 5 which is mounted on the shaft 1 for rotation therewith and which serves for advancing the number wheel 2 from zero position towards one of its operating positions 1-27 or M. An additional gear 6 is similarly mounted on the shaft 1 turnable therewith, and this serves for returning the number wheel 2 in opposite direction from the position M or from one of its operating positions 1-27 to the zero position. The gear 6 cooperates with a pawl 7 which is mounted on a shaft 12, the latter in turn being secured to a stationary component of the copier for swinging movement about the pivot 10. As shown, the pawls 7 and 8 are located on opposite lateral sides of the shaft 1. A tension spring 13 is connected with the pawl 7 at one of its ends, and with the other end the spring 13 is connected to a retaining pin 17 which is also mounted on a stationary portion of the copying device. Similarly, a tension spring 14 is connected to the pawl 8 and a stationary pin 18. The springs 13 and 14 draw the pawls 7 and 8 towards the respectively associated pins 17 and 18, and at the same time they draw the arms 11 and 12 against stationary abutment pins 15 and 16, respectively.

The drawing clearly indicates that the pins 17 and 18 have the function of maintaining the pawls 7 and 8 remote from their respectively associated gears 5 and 6, when the pivotal arms 11 and 12 are in rest position. In this case the number wheel 2 can be turned freely in both directions, with a pin 20 which is here shown as mounted on a leaf spring 19, biasing engaging in respective depressions 2a of the number wheel 2 in order to prevent the latter from accidental movement out of the once-selected position.

There are further provided pins 17a and 18a which are also mounted stationarily on a stationary part of the copier, and which in operating position press respectively associated pawls 7 and 8 into engagement with the gears 5 and 6, respectively, so that they cooperate with the pawls 7 and 8.

The arm 11 is provided with a projection 11a and similarly the arm 12 is provided with a projection 12a. Each of these projections constitutes an armature cooperating with an electromagnetic device 21 and 22, respectively. The device 21 together with the projection 11a serves for operating the pawl 7 in a sense advancing the number wheel 2 from zero position to one of its operating positions. It is connected via conductors 23 and 24 to the electric supply lines 26 and 27; with a micro-switch 25 being interposed in the conductor 23. Additional conductors 29, 30 and 31 cooperate with a micro-switch 28 to connect a device A' with the current supply conductors 26 and 27. The device A' is diagrammatically illustrated and represents those components of the device which become energized periodically, whenever the copying sequence involving the production of a single copy takes place. In other words, every time a copy is made, the components of the device A' are energized and subsequently again deenergized. Such components may be a magnetic coupling which couples the illuminating carriage or the optical scanning device of the electrostatic copying apparatus with the main drive motor, a heating device which may be switched on when a new copy sheet moves into position, a control device which scans the guidance of the copying paper or the like. It is of no particular consequence for the purposes of the present invention if these specific components are incorporated within the definition of the device A', as long as it is understood that all of these components are energized, every time a copy is made. Conductors 32 and 33 connect the device A' with the electromagnetic device 22 so that the latter becomes energized every time a copy is made, that is every time a copying sequence is executed. Thus, whenever a copy is made, the electromagnetic device 22 acts upon the pawl 8 in a sense turning the gear 6 and thereby the shaft 1 and the number wheel 2 incrementally—that is by one step—from the operating position which the number wheel 2 assumes at the time, back towards the zero position.

A second device A is also diagrammatically illustrated and is representative of any or all such components which are continuously energized throughout the copying sequences, that is which will remain energized until the last of a plurality of copying sequences has been completed. Again it is of no importance precisely what components are included in the definition of the device A, but it is pointed out that they may for instance include the current supply for the main drive motor, various lights required for the copying process, the corona discharge device or the like. The device A is connected with micro-switches 34 and 35 via conductors 36 and 37, and via conductors 38 and 39 these micro-switches are also connected with a signal lamp 59 which becomes energized when the machine is in operation to indicate that copying is going on.

A main switch or first means is provided and is identified with reference numeral 37, this being the start switch or start button. A return spring 38 tends to move it to inactivated position as shown in the FIGURE. The start switch 37 is provided with two actuating rods 39 and 40 which each act upon a plate member 42 and 43, respectively, pivotably mounted for movement about the pivot 41 which is in turn mounted on a stationary part of the copier. It is clear from the drawing that when the switch 37 is depressed, the plates 42 and 43 are pivoted in counterclockwise direction. In so doing they act upon the actuating arms 25a, 26a, 34a and 35a of the micro-switches 25, 28, 34 and 35, respectively, thus simultaneously closing these switches and placing them in operative position.

After the switch 37 has been depressed and is released, it immediately returns to its illustrated inactive position under the influence of the spring 38. Simultaneously, the plate 42 is also immediately returned to its inactive position by the biasing action exerted upon it by the actuating lever 25a of the micro-switch 35; this means that the micro-switch 25 removes at once to open circuit-interrupting position.

Matters are different with the plate 43. When the plate 43 is displaced in counterclockwise direction as pointed out before, a projection 48—provided on an arm 48 which is pivotally
46 to a stationary portion of the copying apparatus and which is under the influence of a tension spring 47—engages behind a cooperating projection 43a of the plate 43. Thus, the plate 43 is incapable of returning to its upper rest position when the switch 37 is released. A pin 49 of the arm 48 cooperates with a cam 50 provided on the shaft 1 or on the wheel 2 and having a projection 50a which, when the wheel 2 is in its zero position, abuts the projection 48a and lifts it away from the projection 43a of the plate 43, enabling the latter to move upwardly to its rest position and permitting the micro-switches 28, 34 and 35 to return to their normally open circuit-interrupting position.

In addition there is provided an electromagnet 52 which is connected via conductors 53, 54 and 55 and via switches 56, 57 and 58, with the current supply conductors 26 and 27. An arm 51a is provided on the armature 51 of the magnet 52 and the armature 51 is pivoted at 51b to a stationary portion of the copier. The switch 56 may for instance close in non-illustrated but well known manner when a feeder which engages the supply stack of copying paper (not illustrated) indicates that the paper supply becomes low. Similarly, this switch 57 may close, also in known manner, when the supply of copying paper becomes interrupted. The switch 58, finally, may for instance close when the housing of the electromagnetic copier is opened, for instance by removal of a side wall thereof. None of these features are illustrated because in themselves they do not form a part of the present invention, but it will be appreciated that the switches 56, 57 and 58 are safety switches which operate in case of a malfunction or in case of opening of the housing to protect the device and the users from possible harm. When the switches 56–58 should close, the components in the devices A and A' are immediately de-energized as an automatic response. At the same time, however, the electromagnetic device 52 becomes de-energized in such a case.

In operation of the illustrated electrostatic copier, and as is intended that it is made to have a relatively small number of copies—say 10 of them—the switch 37 is depressed rapidly as many times as copies are desired to be made, that is in this particular example 10 times. Every time the switch 37 is depressed, the microswitch 25 is momentarily closed and the magnet 21 energized. This causes the pawl 7 to act upon the gear 5 in a sense turning the shaft 1 and thereby the number wheel 2 by one increment from its zero position. In other words, the first time the switch 37 is so depressed, the number wheel 2 will be turned from its zero position to the operating position 1 in which the making of one copy is preselected. The first time the switch 37 is so depressed, the projection 50a of the cam 50 moves out of engagement with the arm 48 so that the portion 48a thereof can engage the portion 43a of the plate 43, retaining the latter in its lower position and thus preventing the micro-switches 28, 34 and 35 from returning to open position, so that the components in the devices A, A' and the signal lamp 59 remain energized. As the copier begins the copying sequence in well known non-illustrated manner, the device A' supplies a current pulse to the electromagnet 22 whenever a copying sequence takes place, that is with every copy that is being made. With each such current pulse the magnet 22 acts upon the pawl 8 in a sense returning the number wheel 2 by one increment towards its zero position, and this continues until the zero position is reached. As the number wheel 2 moves from the operating position 1 to the zero position, the projection 50a disengages the arm 48 from the plate 43, permitting the same to move to upper position and permitting the switches 28, 34 and 35 to return to open position to thereby interrupt current supply to all components of the devices A and A', as well as to the signal lamp 59.

If a larger number of copies is desired, where the preselecting by means of the switch 37 would take more time than the manual setting of the number wheel 2, then the number wheel 2 is set to the desired operating position by turning the knob 4. The number of copies so set increases by one when subsequently the switch 37 is depressed; of course, if the switch 37 is depressed more than once then the number of times the switch is depressed must be added to the preselected setting of the number wheel 2 and together these two figures will indicate the number of copies which will be made. If the number wheel 2 has been set with the knob 4 in the manner such as discussed, the operation of the copying sequence is of course the same as described before.

If it is desired to obtain a number of copies which is greater than that for which provision is made on the number wheel 2, that is for instance if 28 or 30 copies are to be provided (the settings on the number wheel 2 only go up to 27), then the number wheel 2 is turned with the knob 4 until its setting M—indicating multi-copying—is in registry with the marker 3. In this case a cut-out 6a provided for this purpose in the gear 6 is located opposite the pawl 8, so that despite the energization of the magnet 22 and movement of the pawl 8, during each individual copying sequence, the pawl 8 is incapable of advancing the gear 6 and therefore cannot return the number wheel 2 towards its zero position. In this case the copying device continues to operate until such time as it is de-activated manually, meaning normally until the desired number of copies—which can be supervised by a suitable counter provided for this purpose (not illustrated) has been reached. At that time the number wheel 2 is returned to its zero position with the knob 4.

It will be seen that by resorting to the present invention the ease of operation of a copying apparatus of the type under discussion is considerably improved and that, similarly, the versatility of the apparatus is improved in terms of making the apparatus more responsive to the individual preferences of different operators.

It will be understood that each of the elements described above, or two or more together, may also be useful in other applications differing from those described above.

While the invention has been illustrated and described as embodied in an electrostatic copier, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed is new and desired to be protected by Letters Patent is set forth in the appended claims.

1. In an electrostatic copier, in combination, first means operable for initiating a copying sequence; second means incrementally advanceable in a first direction from a zero position to a plurality of operating positions in each of which it preselects a specific number of repetitions of said sequence; third means for manually advancing said second means in said first direction; fourth means for incrementally returning said second means in a second direction towards said zero position in response to execution of the respective sequence; and fifth means connected with said first and second means and operative for incrementally advancing said second means in said first direction in response to operation of said first means.

2. In a copier as defined in claim 1, said second means comprising a rotatable shaft and a number wheel mounted on said shaft for rotation therewith.

3. In a copier as defined in claim 2, said fourth means comprising one gear fast with said shaft, one pawl engageable with said gear in a sense turning said shaft in said second direction, and one electromagnetic device operable for engaging said pawl with said gear; and wherein said fifth means comprises another gear fast with said shaft, another pawl engageable with said another gear in a sense turning said shaft in said first direction, and another electromagnetic device operable for engaging said another pawl with said another gear.

4. In a copier as defined in claim 3, further comprising an electrically operated component arranged to be energized
during each copying sequence; and wherein said one electromagnetic device is connected in circuit with said component.

5. In a copier as defined in claim 4, said first means comprising a main switch, and said fifth means further comprising an auxiliary switch in circuit with said another electromagnetic device and operable for energizing the same in automatic response to operation of said main switch; and at least one additional switch in circuit with said component and also operable in a sense energizing said component in automatic response to operation of said main switch.

6. In a copier as defined in claim 5, said auxiliary switch and said additional switch being normally open; and further comprising retaining means operable in response to operation of said main switch and cooperating with said additional switch for maintaining the same in closed position while said second means is in a position other than said zero position.

7. In a copier as defined in claim 6; further comprising at least one additional electrically operated component arranged to be energized during each copying sequence; and at least one other normally open additional switch in circuit with said additional component and cooperating with said retaining means so as to be maintained thereby in closed position while said second means is in a position other than said zero position.

8. In a copier as defined in claim 7; and an actuating element operatively connected with said main switch and said one and said other additional switches for displacing both of

the latter from said normally open to said closed positions in response to operation of said main switch, and for operating said retaining means.

9. In a copier as defined in claim 6; further comprising cam means on said number wheel and operative for releasing said retaining means in a sense permitting return of said auxiliary and said additional switches to said normally open position in automatic response to said number wheel returning to said zero position.

10. In a copier as defined in claim 6; further comprising at least one safety switch operable in automatic response to occurrence of a predetermined safety hazard; and a further electromagnetic device in circuit with said safety switch and acting upon said retaining means in a sense effecting release of said auxiliary and said additional switches in response to operation of said safety switch.

11. In a copier as defined in claim 3, said second means being advanceable to a continuous-copying position via said third means; and further comprising defeat means for defeating operation of said fourth means when said second means is in said continuous-copying position.

12. In a copier as defined in claim 11, said defeat means comprising a cut-out provided in said one gear and located opposite said one pawl when said second means is in said continuous-copying position, to thereby preclude engagement of said one pawl with said one gear.